embodiment, the plurality of fluidic zones comprises a sample zone, a cleaning zone and/or a detection zone. In a further embodiment, it comprises more than one sample zone, cleaning zone, and/or detection zone. It can comprise additional fluidic zones for storing reagents, which can be branches of any of the aforementioned zones. In one embodiment, multiple fluidic zones are contained in parallel within the same device, thus allowing for analysis of multiple samples or multiple analytes in parallel. Each fluidic zone is separated from the adjacent fluidic zone by a diffusion barrier.

[0157] Diffusion barriers connect the fluidic zones of the device. They are designed and situated to minimize diffusion or convectance of the contents of one fluidic zone to the next fluidic zone, such that the majority of the contents that move from one zone to the next fluidic zone are moved by directed fluidic flow and/or by activating the magnetic microcoil array. In certain embodiments, the diffusion barrier is a fluidic channel that is designed to alter the path of the fluidic zone. In other embodiments, the diffusion barrier is a thermally-sensitive barrier. Hydrophilic fluid or liquid can be contained in a shape of droplets surrounded by hydrophobic liquid such as silicone oils to form strong diffusion barriers through hydrophilic-hydrophobic interactions so that droplets can be separated and transported without mixing with other fluids as demonstrated in J. Micromech. Microeng. (2006) 16:1875 and Sensors and Actuators B (2006) 113:563. A diffusion barrier can be accomplished by "particle trapping and transport" through DEP (dielectrophoresis) as demonstrated in Biophysical Journal (1998) 74:1024 and Sensors and Actuators A 121 (2005) 59.

[0158] The detection element is situated in proximity to the detection zone. The detection element can be an optical detection element or an electrical detection element. In certain embodiments, the optical detection element is selected from a Raman detector, a photon multiplier tube, a fluorescent reader, or an electrochemical sensor and the electrical detection element is selected from a FET element, a capacity detection element, a current sensor, and a charge sensor. Typically, the detection of the binding complex or the signal analyte complex indicates the presence of the analyte.

[0159] In further embodiments, the detection zone comprises a reaction substrate that interacts with a catalytic element to form a fluorogenic, chemiluminescent, or chromogenic product. Non-limiting examples of reaction substrates include Lumigen APS-5, Lumigen TMA-6, Lumigen PS-atto, Lumigen PS-3, H_2O_2 with an oxidizable compound, Amplex Red, 3,5,3',5'-tetramethylbenzidine (TMB), glucose, O_2, ATP, Mg^{2+}, luciferin, inoluciferin, quinolinyl, coelentrazine, aldehyde, $FMNH_2$, and analogs and combinations thereof.

[0160] Typically, if the detection zone comprises a reaction substrate, the magnetic particle and/or the signal particle comprises a catalytic element that serves as an agent to cause a chemical reaction to occur in the reaction substrate, where the reaction product is detectable by the detection element. In certain non-limiting embodiments, the catalytic element is selected from the group consisting of alkaline phosphatase, horseradish peroxidase, glucose oxidase, luciferase (from firefly, *Renilla*, bacteria, or other sources) or analogs or combinations thereof. The catalytic element can be covalently or non-covalently conjugated to the signal particle through a functionalized polymer. The fluidic zones of the device generally contain an appropriate buffer to permit the reaction to occur.

[0161] The sample zone of the device comprises a magnetic particle selected from the group consisting of a magnetic affinity complex and a coded magnetic affinity complex. Magnetic particles may also be present within other fluidic zones of the device. The microcoils are activated in such a manner as to move the magnetic particles within the device.

[0162] The sample zone or other zone of the device can also comprise a signal particle selected from the group consisting of signal affinity complexes, signal analyte complexes, and coded magnetic signal affinity complexes, among others. In certain embodiments the signal particle is a SERS-active nanoparticle, a fluorescent nanoparticle, a nanoparticle coupled to a surface-enhanced fluorescent tag, or a core nanoparticle covalently coupled to a catalytic element. In one embodiment, the signal particle is a COIN particle. In other embodiments, the signal particle is a Qdot, or another fluorescent nanoparticle, such as SEF nanoparticle or a FluoDot. In further embodiments, the signal particle is any nanoparticle (i.e. gold, silver, CdS, CdSe, copper, Eu^{3+}-coated polymer, an organic polymer (homo or hetero), an inorganic compound, or composite compounds, etc.). Additionally, the SERS-active nanoparticle and fluorescent nanoparticle can also be functionally coupled to a catalytic-element. In certain embodiments, the sample zone of the fluidic device comprises the signal particle. Alternatively, the sample particle is contained within another fluidic zone. In further embodiments, different or the same signal particles can be contained within more than one fluidic zone.

[0163] Embodiments of the invention also include methods of using the devices to detect the presence of an analyte.

[0164] The device contains magnetic particles within one or more fluidic zones, and the microcoil array is activated to thereby move the magnetic particles within that zone or to another zone. In one method, the magnetic particle within the sample zone is a magnetic affinity complex. A sample suspected of comprising an analyte is introduced into the sample zone, wherein the magnetic affinity complex binds to the analyte to form a magnetic binding complex. The microcoil array is activated to move the magnetic binding complex from the sample zone to another fluidic zone.

[0165] In another embodiment, the magnetic particle is a magnetic signal affinity complex. A sample suspected of comprising an analyte is introduced into the sample zone, wherein the magnetic signal affinity complex binds to the analyte to form a magnetic signal binding complex. The microcoil array is activated to move the magnetic signal binding complex from the sample zone to another fluidic zone. It is then detected by the detection element, indicating the presence of the analyte.

[0166] In another embodiment, one or more fluidic zones also comprise a signal affinity complex. The analyte is combined with the magnetic affinity complex and the signal affinity complex, either simultaneously or sequentially, where the magnetic affinity complex and the signal affinity complex bind to the analyte to form a sandwich binding complex. The microcoil array is activated to move the sandwich binding complex to the detection zone of the fluidic network, where it is detected by the detection element, and where the detection of the sandwich binding complex indicates the presence of the analyte. In such an embodiment, the analyte is typically a protein, an antibody, or a nucleic acid.

[0167] In a further embodiment, the sample zone comprises a magnetic affinity complex, and one or more fluidic zones comprise a signal analyte complex. The magnetic affinity